Abundance of Zooplankters on a Rocky Shore of Lake Tanganyika: A Preliminary Report

AUTHOR(S):

KONDO, Takaki; HORI, Michio

CITATION:

KONDO, Takaki ...[et al]. Abundance of Zooplankters on a Rocky Shore of Lake Tanganyika: A Preliminary Report. African Study Monographs 1986, 6: 17-23

ISSUE DATE:

1986-02

URL:

https://doi.org/10.14989/68015

African Study Monographs, 6: 17-23, February 1986

ABUNDANCE OF ZOOPLANKTERS ON A ROCKY SHORE OF LAKE TANGANYIKA: A PRELIMINARY REPORT

Takaki KONDO
Department of Biology, Osaka Kyoiku University
Michio HORI
Department of Biology, Wakayama Medical College

ABSTRACT Abundance of zooplankters was examined by net collection on a rocky shore at the northwestern end of Lake Tanganyika in February 1980 and August 1983. Zooplankters found were *Mesocyclops leuckarti, Diaptomus simplex, Ergasiloides* sp. (Copepoda), Ostracoda, shrimps, *Asplanchna* sp. (Rotifera) and *Vorticella* sp. (Protozoa). Species composition of zooplankton was rather simple and characterized by the dominance of Copepoda, especially nauplii and cyclopoid copepodites. Nauplii smaller than 0.2 mm in body length were more abundant in August than in February, which suggests that the reproductive activity of copepods changes seasonally. The density of zooplankters tended to be lower at the bottom in the daytime, probably because of the predation by fish. The density of copepods changed with the time of day; low at noon and high in the afternoon. Such diel fluctuation in the abundance of copepods may influence the feeding activity of fish.

INTRODUCTION

There are few studies on the abundance of zooplankters in Lake Tanganyika (Burgis, 1984; Mizuno, 1984; Narita et al., 1985). These studies were carried out in the pelagic regions. However, there is no study on the abundance of zooplankters on rocky shores where the number of fish species is abundant.

This paper presents the results of two surveys carried out on a rocky shore at the northwestern end of Lake Tanganyika.

STUDY AREA AND METHODS

Surveys were carried out on a rocky shore of Luhanga, on the northwestern coast of Lake Tanganyika in February 1980 and August 1983. Circumstances of the rocky shore is described by Hori et al. (1983). All zooplankton samplings were made by using a plankton net (20 cm in diameter, 94 μm in aperture, NXX 13 in 1980 and 30 cm in diameter, 69 μm in aperture, NXX 17 in 1983) with the aid of SCUBA.

In 1980, samples were taken vertically and horizontally at various sites and depths in the daytime (15:00) on February 20 and at night (20:00) on February 23.

In 1983, they were taken vertically from bottom to surface in the layers of 0–1 m, 1–2 m, 2–3 m, 3–4 m and 4–5 m every three hours during the daytime from 9:00 on August 26 to 9:00 on August 27. A sample was collected vertically from bottom to surface (0–5 m) at night of August 26. A water sample was also collected at 4.5 m in depth (0.5 m above the bottom) by a reversing water sampler each time. Water temperature was measured by a thermometer, pH by a pH meter made by Japan Feeder Co., and dissolved oxygen was examined by the Winkler's method. Using an underwater stop watch and a measure, velocity of water cur-

Table 1. Diel changes in weather, temperature, pH and dissolved oxygen on August 26–27, 1983.

	9:00	12:00	15:00	18:00	21:00	6:00	9:00
Weather	cloudy	fine	fine	fine	cloudy	cloudy	fine
Air temperature (°C)	25.4	26.8	27.1	25.9	25.2	22.7	26.4
Water temperature (°C)	26.0	26.5	26.4	26.1	25.9	25.9	26.0
pH	9.3	9.3	9.3	9.3	9.4	9.4	9.4
Dissolved oxygen (ml/L)	4.09	4.25	4.22	4.19	4.10	4.13	4.22
(%)	78.4	82.2	81.5	80.4	78.4	79.0	80.8

Table 2. Mean density of zooplankters on a rocky shore (No. of animals per liter). A: from bottom to surface, S: surface, M: middle layer of 8 m deep, B: bottom.

	Date	February 20, 1980 (15:00)					
	Depth	11 m	1.5 m	1.5 m	5 m	10 m	10 m
Species	Layer	A	S	B	S	M	B
Copepoda							
Nauplii		5.2	0.3		1.0	2.4	1.8
Cyclopoid copepodites		11.9	2.2	0.1	4.0	4.8	2.8
*Mesocyclops leuckarti**		0.2					
Diaptomus simplex		0.2	0.1		0.3	0.2	0.03
Ergasiloides sp.		0.1	0.1				0.1
Ostracoda				0.2		0.1	
Protozoa							
Vorticella sp.						0.1	0.1

	Date	February 23, 1980 (20:00)					
	Depth	1.5 m	1.5 m	5 m	5 m	10 m	10 m
Species	Layer	A	B	A	B	A	B
Copepoda							
Nauplii		59.4	15.3	27.4	12.6	40.9	17.8
Cyclopoid copepodites		39.5	16.8	14.9	8.9	33.8	12.2
*Mesocylops leuckarti**		1.1	0.4	0.2	0.2	0.2	0.4
Diaptomus simplex		0.8	1.1	0.8	0.5	0.7	1.6
Ergasiloides sp.			0.1		0.4	0.3	3.1
Ostracoda			0.3				1.6
Shrimps			0.03			0.2	0.02
Protozoa							
Vorticella sp.		6.4	0.1	0.6		1.2	0.1

	Date	August 26–27, 1983						
	Time	9:00	12:00	15:00	18:00	21:00	6:00	9:00
	Depth	5 m	5 m	5 m	5 m	5 m	5 m	5 m
Species	Layer	A	A	A	A	A	A	A
Copepoda								
Nauplii		87.2	30.5	148.0	122.7	38.8	62.5	101.8
Cyclopoid copepodites		31.6	13.0	35.4	40.3	13.4	53.2	35.2
*Mesocyclops leuckarti**		1.9	0.7	0.8	2.1	0.5	2.7	1.2
Diaptomus simplex			0.1		0.1	0.5		
Ergasiloides sp.		0.1					1.6	
Ostracoda		1.4	0.3	2.2	1.4	0.3	2.2	1.0
Shrimps						0.03		
Rotifera								
Asplanchna sp.		0.1						
Protozoa								
Vorticella sp.				0.2		0.6	0.2	0.2

*adults only

rent just above the bottom was determined by recording the passing time of floating matter across a distance of 5 cm several times on August 26–27, 1983.

The zooplankters preserved with 2% formalin solution were identified and counted under a microscope in the laboratory, and body length of the first 100 copepods in each sample were measured by using an ocular micrometer.

RESULTS AND DISCUSSION

Water Temperature, pH and Dissolved Oxygen

Surface water temperature was 27.0°C and 26.4°C on February 20 and 23, 1980 respectively. It ranged between 24 and 28°C from October 1960 to February 1962 at the southern end of the lake (Coulter, 1963), between 25.8 and 27.5°C from November 1981 to August 1982 at the northern end of the lake (Narita et al., 1985) and between 25.7 and 27.2°C from July to November 1983 in the study area (Kondo, unpublished data). Thus, water temperature is relatively constant throughout the year.

Diel changes in water temperature, dissolved oxygen and pH were examined at 4.5 m in depth (Table 1). They were rather constant throughout the day, but the former two tended to be high at noon and low at night.

Species Composition of Zooplankton

The zooplankton was composed of *Mesocyclops leuckarti*, *Diaptomus simplex*, *Ergasioloides* sp., Ostracoda, shrimps. *Asplanchna* sp. and *Vorticella* sp. (Table 2). The species composition was rather simple and characterized by the dominance of Copepoda, especially nauplii and cyclopoid copepodites. Sometimes, medusoid coelenterate *Limnocnida tanganyicae* was observed, but a medusa was not caught in the present study.

A total of 34 species of Cyclopidae have been reported in Lake Tanganyika (Sars, 1909; Gurney, 1928; Lindberg, 1951), but only *Mesocyclops leuckarti* was collected in the study area.

Although Harding (1957) found 6 species of Cladocera in shallow waters of the lake, no Cladocera were collected.

Many shrimps were found on and among rocks and stones in the daytime, but they were observed swimming in open water at night. Thus, shrimps were collected only at night by use of a plankton net.

Rousselet (1910) found 10 species of Rotifera in Lake Tanganyika, but Gillard (1957) did not, though he described 62 forms of Rotifera in pools and swamps around the lake. In the present study, *Asplanchna* sp. was found in a sample collected in the morning of August 26, 1983. Moreover, many mandibles of *Asplanchna* were found in the stomach of a planktophagous fish *Lamprologus brichardi* caught in the study area on August 10, 1983. Thus, *Asplanchna* may not be rare in the study area.

A small number of *Vorticella* sp., most of which settled on detritus and formed collonies, were observed. They may have been detached from the substratum by wave action.

Abundance

Nauplii and cyclopoid copepodites were abundant, but adults of *Mesocyclops* were scarce in both years (Table 2). On the average, nauplii represented 23.8% of the copepods collected on February 20, 55.7% on February 23 and 71.6% on August 26–27, respectively. Nauplii smaller than 0.2 mm in body length were far less abundant on February 20 and 23 than on August 26–27 (Fig. 1). In tropical Lake George, mean development-times of eggs and nauplii of

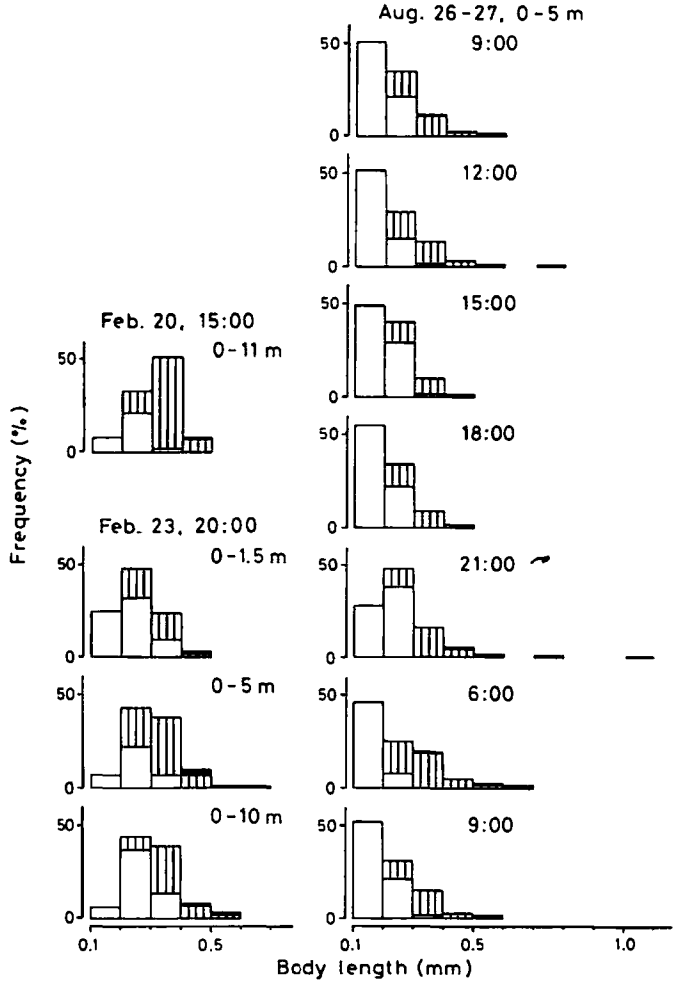

Fig. 1. Size frequency distributions of copepods collected by the vertical hauls from bottom to surface in February 1980 and August 1983. Open, shaded and solid areas represent nauplii, cyclopoid copepodites, and *Diaptomus* and *Ergasiloides*, respectively.

Thermocyclops hyalinus were 1.5 and 6 days, respectively (Burgis, 1971). Since water temperature is rather constant throughout the year and almost the same as in Lake George, development-times of eggs and nauplii of *Mesocyclops* and *Diaptomus* may be not so different from those of *T. hyalinus*. Thus, the poorness of small nauplii in February 1980 may be due to the low reproductive activity of copepods.

Mean density of nauplii at the shore was 1.7 and 28.9 individuals per liter in the afternoon of February 20 and at night of February 23, 1980 respectively. That of cyclopoids was 4.3 and 21.4 individuals per liter, respectively. In the pelagic region at the north end of the lake, on the other hand, densities of nauplii and cyclopoids at the layer of 0–5 m were 36 and 65 individuals per liter, respectively in the morning of February 25, 1980 (Mizuno, 1984). These results suggest that nauplii and cyclopoids are less abundant at the shore than offshore.

Vertical Distribution

Distribution of zooplankters was examined by horizontal hauls at several sites in 1980 (Fig. 2). The density of zooplankters was lower at the bottom in the afternoon. On the other hand, it was not so different among sites at night. Since most fish are diurnal, predation by fish may be a cause of the lower density of zooplankters at the bottom in the afternoon.

Fig. 3 shows the diel change in the vertical distributions of nauplii and cyclopoid copepodites from bottom to surface. They tended to be more abundant in the middle layers throughout the day. The total density of copepods was low at noon and suddenly increased in the afternoon when water flowed (Fig. 4). The relationship between the current velocity and the total density of copepods was significant only in the layer of 4–5 m deep ($r = 0.92$, $P<0.01$). At Luhanga and most of the littoral area along the northwestern coast of Lake Tanganyika, a weak current from offshore usually occurs in the afternoon, which is caused by wave action due to the strong wind from the south and southeast. This suggests that copepods are brought from offshore in the afternoon, because copepods were more abundant in the open water than at the shore as mentioned earlier. The sudden increase of copepods at the shore in

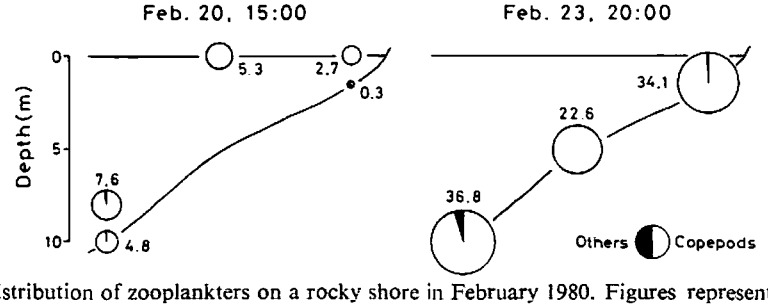

Fig. 2. Distribution of zooplankters on a rocky shore in February 1980. Figures represent the total number of animals per liter.

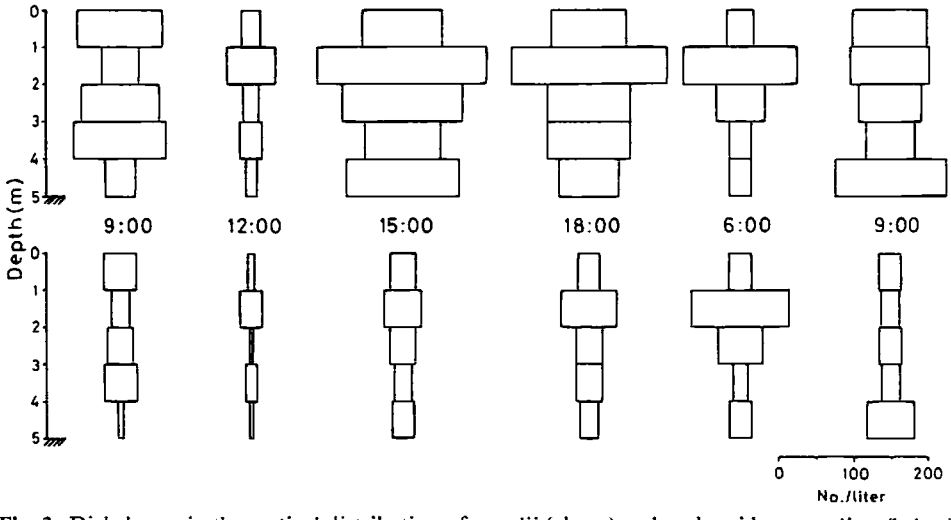

Fig. 3. Diel change in the vertical distribution of nauplii (above) and cyclopoid copepodites (below) from bottom to surface on August 26–27, 1983.

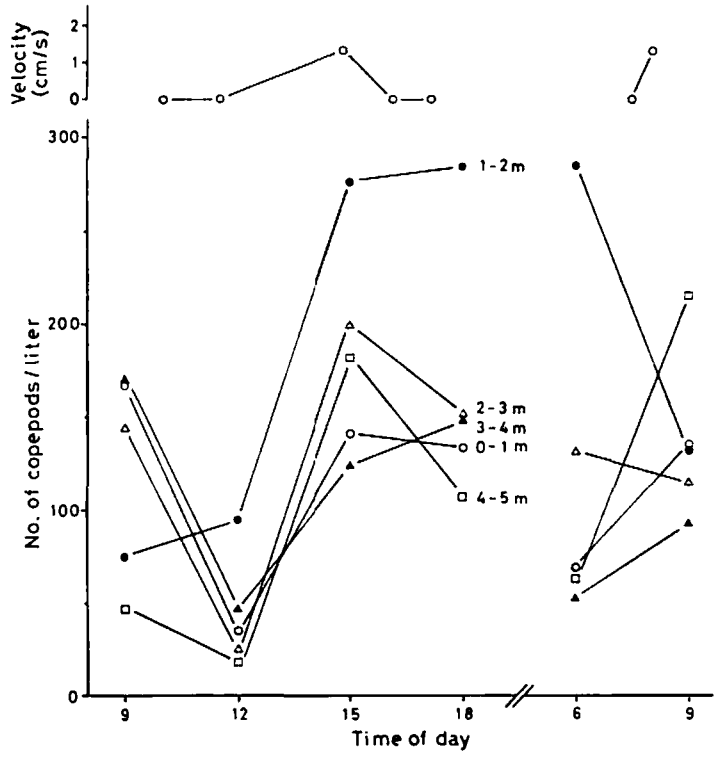

Fig. 4. Diel change in the current velocity at the bottom and the total density of copepods in each layer on August 26–27, 1983.

the afternoon may be caused by the transportation of copepods from offshore by the current. Such diel fluctuation in the abundance of copepods may greatly affect the feeding activity of fish.

ACKNOWLEDGEMENTS We wish to express our heartful thanks to the Délégué Général and other members of I.R.S. of Zaire, especially Director Menga Kuluki Kwetuenda and all other staff of the I.R.S./Uvira Station, for their official and private support during our stay at Uvira. We are also grateful to Professor Hiroya Kawanabe, Dr. Tetsuya Narita and Dr. Masahide Yuma, Kyoto University, Dr. Yasunobu Yanagisawa, Ehime University, and Dr. Toshihiko Mizuno, Aoyama College at Osaka, for a critical reading of the manuscript and helpful suggestion.

This study was supported by the Grant-in-Aid for Overseas Scientific Survey (Nos. 404130, 504328, 57043028, 58041043 and 59043039) from the Ministry of Education, Science and Culture, Japan.

REFERENCES

Burgis, M. J. 1971. The ecology and production of copepods, particularly *Thermocyclops hyalinus*, in the tropical Lake George, Uganda. *Freshwat. Biol.*, 1: 169–192.

Burgis, M. J. 1984. An estimate of zooplankton biomass for Lake Tanganyika. *Verh. Internat. Verein. Limnol.*, 22: 1199–1203.

Coulter, G. W. 1963. Hydrological changes in relation to biological production in southern Lake Tanganyika. *Limnol. Oceanogr.*, 8: 463–477.

Gillard, A. 1957. Rotiféres. *Explor. Hydrobiol. Lac Tanganyika* (1946–1947), III. 6: 1–26.

Gurney, R. 1928. Some copepoda from Tanganyika collected by Mr. S. R. B. Pask. *Proc. Zool. Soc., London*, 22: 317–332.

Harding, J. P. 1957. Crustacea: Cladocera. *Explor. Hydrobiol. Lac Tanganyika* (1946–1947), III. 6: 55–89.

Hori, M., K. Yamaoka and K. Takamura 1983. Abundance and micro-distribution of cichlid fishes on a rocky shore of Lake Tanganyika. *African Study Monographs*, 3: 25–38.

Lindberg, K. 1951. Cyclopoides (Crustacés Copépodes). *Explor. Hydrobiol. Lac Tanganyika* (1946–1947), III. 2: 47–91.

Mizuno, T. 1984. Daily and seasonal changes of plankton in northern part of Lake Tanganyika (In Japanese). *Memorial Publication in Commemoration of Professor T. Mizuno's Retirement*, 1–9.

Narita, T., N. Mulimbwa and T. Mizuno 1985. Vertical distribution and seasonal abundance of zooplankton in Lake Tanganyika. *African Study Monographs*, 6: 1–16.

Rousselet, F. R. M. S. 1910. Zoological results of the third Tanganyika expedition, conducted by Dr. W. A. Cunnington, F.Z.S., 1904–1905. Report on the Rotifera. *Proc. Zool. Soc., London*, 1910: 792–799.

Sars, G. O. 1909. Zoological results of the third Tanganyika expedition, conducted by Dr. W. A. Cunnington, F.Z.S., 1904–1905. Report on the Copepoda. *Proc. Zool. Soc., London*, 1909: 31–77.

—Received *March 26, 1985*

Authors' Names and Addresses: Takaki KONDO, *Department of Biology, Osaka Kyoiku University, 4-88 Minami-kawahori-cho, Tennoji-ku, Osaka 543, Japan*; Michio HORI, *Department of Biology, Wakayama Medical College, 651 Hironishi, Wakayama 649-63, Japan.*